

XV.—On the Localization of the Regenerative Surfaces in the Phasmidæ. By EDMOND BORDAGE*.

AFTER a series of experiments I have succeeded in ascertaining that the regeneration of limbs in Phasmids, in consequence of artificial amputation, only took place when the amputation had been performed in the region comprising the tarsus and the lower third of the tibia †; so that the only possible localities for the phenomena of regeneration were the region indicated and the surface of section corresponding to the line of fusion between the trochanter and femur, which was laid bare after autotomy. If there had been mutilations in the shape of amputations performed at different levels, the regenerative power would have manifested itself throughout the entire length of the limb, and would certainly have resulted in the reproduction of the whole of the missing portion, at whatever point these amputations had taken place.

I was therefore led to seek for the reason of such special localizations as these, and I have studied the manner in which the principal vertebrate enemies of *Monandroptera* and *Rhaphiderus* attack these insects and lay hold of them.

Birds, as I have been able to assure myself, are ill adapted to provoke autotomy or to mutilate the lower region of the limbs. They kill the insects immediately by dealing them repeated blows with their beaks. I have noticed this fact especially in connexion with the common myna (*Acridotheres tristis*), the great destroyer, *par excellence*, of grasshoppers and Phasmids.

Lizards have yielded me more interesting results. I have observed the mode of procedure of the "bloodsucker" (*Calotes versicolor*) in order to seize a Phasmid. The Orthopteron supports itself on its long bent legs, its body balanced in the strangest manner while walking, and even during repose, if the least breath of air makes itself felt. The abdomen is raised and bent back in a semicircle, an attitude which is especially remarkable in the young larvæ. It most frequently happens that the lizard, darting at the insect, seizes it by the abdomen or by the thorax and devours it

* Translated by E. E. Austen from the 'Comptes Rendus Hebdomadaires des Séances de la Société de Biologie,' t. v. no 28, 5 août, 1898, pp. 837-839: from a separate impression communicated by the Author. Cf. Ann. & Mag. Nat. Hist. ser. 6, vol. xx. (1897) pp. 473, 476, and 507.

† *Vide* Bull. de la Sec. entomol. de France, séance du 13 juillet, 1898.

immediately. It is not so when the insect is a somewhat large one and is attacked by a *Calotes* of small size. In most cases the latter can only seize its prey by a limb. Then, by little abrupt and rapid movements, performed by relaxing a very little and then immediately tightening the grip of its jaws, which advance, so to speak, little by little, mounting up the limb, it finally reaches the body itself. I was never able to discover that its teeth severed the limb. They merely plant themselves more or less deeply in the chitinous sheath. The insect struggles and clings to the nearest objects by means of the claws with which the tarsi are terminated. This results in very severe strains on all the limbs, but especially on the leg which is seized. Not infrequently when the teeth reach the upper half or upper third* of the femur they may produce autotomy by breaking, if they penetrate deeply enough through the chitinous sheath. In certain cases, after having thus abandoned a limb, the insect, if upon a branch, allows itself to fall to the ground. In this manner it sometimes succeeds in hiding itself in the grass and in throwing its enemy off the scent. But in most cases it does not act thus, and confines itself to fleeing before the lizard. The latter speedily catches it up and renews its tactics, which in most instances end in the death of the Orthopteron.

When—which is of somewhat rare occurrence—the *Calotes* has only been able to seize the terminal extremity of the limb, the result, thanks to the relative fragility of this region, is the removal of a portion or of the whole of the tarsus, either by a pretty clean cut or by being pulled off. These mutilations must have contributed to the development of the regenerative faculty possessed by the tarsus and the lower third of the tibia; for the muscular fibres which move the joints of the tarsus have their attachments precisely in this portion of the tibia, and are subjected, beyond doubt, to strains and lesions, constituting a mode of excitation which is sufficient to explain the cases of regeneration exhibited by this lower third of the tibia.

We must not take any account of ants, whose bites can only provoke autotomy, and never mutilations of other kinds. The action of these bites is a purely *chemical* one, and could only have succeeded in manifesting itself at the outset of the period at which the special disposition which ensures spontaneous amputation had been subjected, in course of time, to

* The only region at which it is possible to provoke autotomy by cutting, pinching, or breaking.

a real process of improvement and had acquired a sufficient degree of sensitiveness. Moreover, ants only make their appearance during the tertiary epoch.

The perfecting process must likewise have been accelerated by the difficulty experienced by the larva in emerging from the egg-shell. At this time it frequently happens that the tarsus of one of the limbs remains fixed in the hard round shell, which is then dragged along like a ball by the insect. Severe strains result from this every moment, when the shell is caught in some obstacle. These strains, if not always sufficient to produce autotomy, nevertheless pretty often bring about the mutilation of the tarsus, which, after being torn off, is abandoned either in its entirety or else merely in part, together with the egg-shell. This, then, must again have contributed to the development of the regenerative faculty possessed by the tarsus and the lower third of the tibia.

Saurians and Batrachians, represented by the Stegocephali as early as the primary epoch, then certain small mammals beginning with the secondary epoch, although they do not appear to be able to produce mutilations in the shape of clean amputations of the femur and tibia, were nevertheless capable of contributing to the development of the regenerative faculty in the tarsal region, as well as to the perfecting of autotomy. But their attacks could not have been one of the primary causes of the appearance of the special disposition permitting autotomy first and regeneration afterwards.

In a communication shortly to appear I propose to seek for these primary causes.

MISCELLANEOUS.

Note on Papilio glycerion, Gray.

By F. A. HERON, Assistant, British Museum (Natural History).

IN 1831 no. 1 of Gray's 'Zoological Miscellany' contained, on page 32, the short Latin diagnosis by Geo. Robert Gray printed below :—

"*Papilio Glycerion*.—*P. alis flavescens, fasciis nigris; posticis caudatis apice nigro, lunulis marginalibus cæruleis, angulo ani striga flava. Expansio alarum 3 poll. Habitat in Nepal.*"

The original of the description is said to be in the collection of General Hardwicke.

Twelve years later—in 1843—Boisduval (*Spec. Gén. Lép. i.*